



New geographic records of four species of Asphondyliini (Insecta, Diptera, Cecidomyiidae)

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Abstract

The geographic distribution of four gall-inducing species, *Asphondylia cordiae* Mohn, 1959, *A. serrata* Maia, 1994, *Bruggmanniella byrsonimiae* Maia & Couri, 1993 and *B. doliocarpi* Maia, 2010 (Diptera, Cecidomyiidae) is widened based on the examination of galled exsiccates of two Brazilian herbaria, one in Museu Nacional (Rio de Janeiro) and the other in Jardim Botânico do Rio de Janeiro. New records include one country, one phytogeographic domain, eight states and five municipalities. The distributional area of each gall midge species is compared with that of its host plant.

Keywords

Insect gall, gall midges, host plant, insect-plant interaction, phytogeographic domains.

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Introduction

Cecidomyiidae are one of the most diverse families of Diptera with more than 6,500 described species, most of them being gall-inducers (Gagné and Jashhhof 2017). Due to this habit, they are commonly known as “gall midges” (Gagné 1994). They are generally monophagous and each species induces a gall with unique morphology and histology (Shorthouse et al. 2005). This specificity of host plant and gall morphotype allows the use of the galls’ presence as indicative of the gallers’ presence.

The geographic distribution of several Brazilian species is poorly known, being most species known only from the type localities (Gagné and Jaschhof 2014). Arriola et al. (2016) showed that data on geographic records of gall-inducing species can be retrieved from herbaria by examination of galled exsiccates. Thus, new

locality records can be obtained from these sources of information.

The present study aims to contribute to the knowledge about the geographic distribution of four Asphondyliini species: *Asphondylia cordiae* Möhn, 1959, *A. serrata* Maia, 2004, *Bruggmanniella byrsonimiae* Maia & Couri, 1993, and *B. doliocarpi* Maia, 2010.

Methods

Data on host plants and gall morphology were verified in the original descriptions of the gall-inducing species (Möhn 1959; Maia 2004; Maia et al. 1993, 2010). Then, a literature review was done using Google Scholar in order to compile the geographic records of *Asphondylia*

cordiae, *A. serrata*, *Bruggmanniella byrsonimiae*, and *B. doliocarpi* based on host plants plus gall morphology as well as on the gall-inducing species. The Jardim Botânico do Rio de Janeiro Herbarium (RB) and the Museu Nacional Herbarium (R) were visited once a week from June, 2018 to April, 2019. Exsiccates of the host plant species, *Cordia alba* (Jacq.) Roem. and Schult. (Boraginaceae), *Varronia curassavica* Jacq. (Boraginaceae), *Eremanthus erythropappus* (DC.) MacLeish (Asteraceae), *Byrsonima sericea* DC. (Malpighiaceae), and *Doliocarpus dentatus* (Aubl.) Standl. (Dilleniaceae) were searched and examined under a stereomicroscope. Galled specimens, their labels and gall morphotypes were photographed. Geographical coordinates were copied from the labels. Errors were corrected based on google maps. The herbaria data were compared with literature data in order to determine new locality records.

Botanical names were verified in the site “Flora do Brasil” in order to check the correct spelling and synonyms. The geographic distribution of each plant species in Brazil (2020) was also obtained from the same site. Phytogeographic domains were verified based on the map of biomes of Brazil (IBGE 2004). The current distribution of each gall-inducing species and that of its respective host plant are given. All gall-inducing species were identified based on host plant species plus gall morphology.

Results

A total of 788 exsiccates of four plant species were examined, 31 of them were galled (*Varronia curassavica*, $n = 20$; *Eremanthus erythropappus*, $n = 6$; *Byrsonima sericea*, $n = 2$; and *Doliocarpus dentatus*, $n = 3$).

Asphondylia cordiae Möhn, 1959

New records. BRAZIL: state of Espírito Santo, Anchieta-Piúma; 20°48'21"S, 040°38'52"W–20°50'06"S, 040°43'44"W; G.J. Sheperd, J. Semir, J.B. Andrade col. leg.; Atlantic Forest, Restinga; voucher number: R143.182; state of Rio Grande do Sul, Porto Alegre; 30°01'59"S, 051°13'48"W; Vidal, J. leg.; Atlantic Forest; voucher number: R 65.623; state of Rio de Janeiro, Campos dos Goytacazes; 21°45'15"S, 041°19'28"W; Sampaio A. leg.; Atlantic Forest, Restinga; voucher number: R 65.055; state of Rio de Janeiro, Quissamã; 22°06'24"S, 041°28'20"W; M.C. de Oliveira, E. de Faria, F.F. Moreira, and L. G. de Santana col. leg.; Atlantic Forest, Restinga; voucher number: R 200.115; state of Rio de Janeiro, Rio de Janeiro, Barra da Tijuca; 22°54'13"S, 043°12'35"W; M. Emmerich, L. Scheinvar col. leg.; Atlantic Forest, Restinga; voucher number: R 204.772; State of São Paulo, Ubatuba; 23°26'02"S, 045°04'16"W; N. Taroda col. leg.; Atlantic Forest; voucher number: R 143.235.

Identification. Galls induced by *Asphondylia cordiae* Möhn, 1959 on flower buds of *Varronia curassavica* are ovoid, green, with whitish trichomes, and one-chambered (Fig 1A).

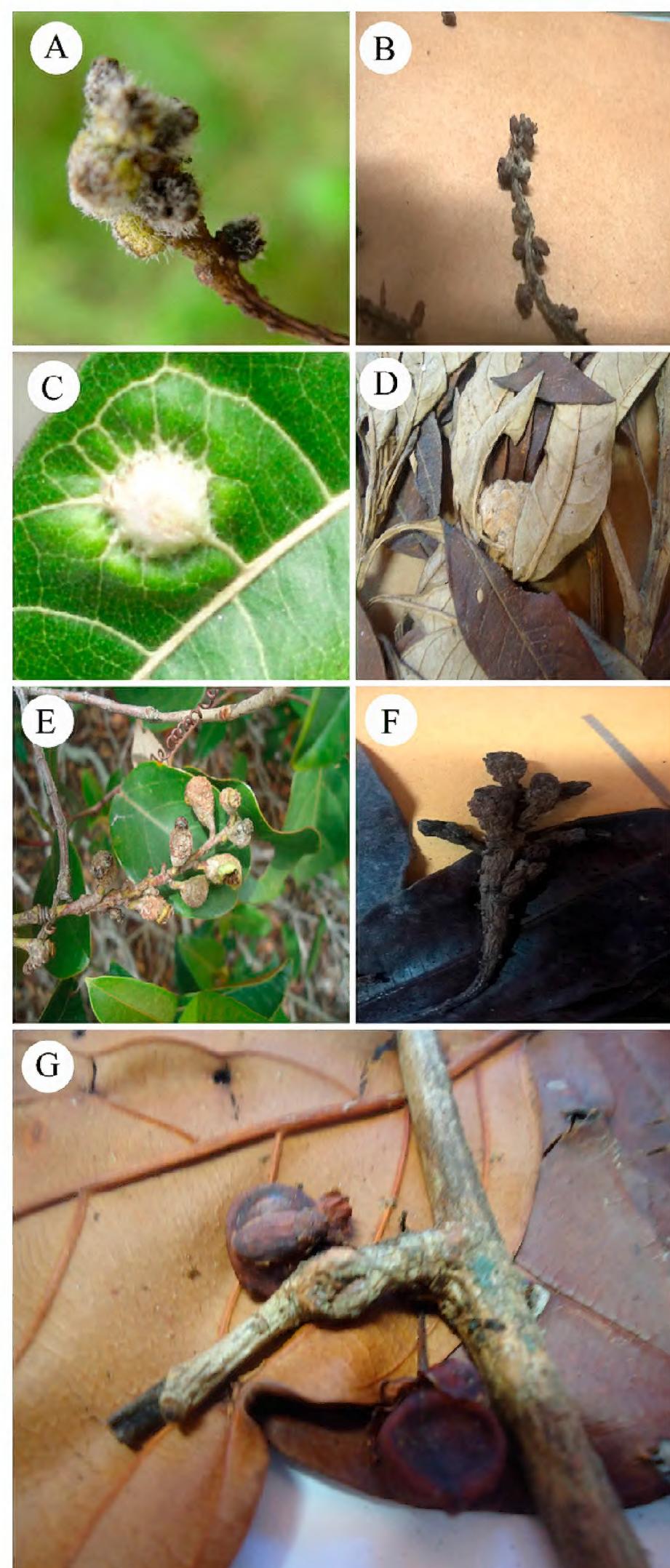


Figure 1. Galls of four species of Asphondyliini. **A.** Gall induced by *Asphondylia cordiae* Mohn, 1959 (Diptera, Cecidomyiidae) on *Varronia curassavica* Jacq. (Boraginaceae). **B.** Gall induced by *A. cordiae* on exsiccata of *V. curassavica*. **C.** Gall induced by *Ashondyliia serrata* Maia, 2004 (Diptera, Cecidomyiidae) on *Eremanthus erythropappus* (DC.) MacLeish (Asteraceae). **D.** Gall induced by *A. serrata* on exsiccata of *E. erythropappus*. **E.** Galls induced by *Bruggmanniella byrsonimiae* Maia & Couri, 1993 on *Byrsonima sericea* DC. (Malpighiaceae). **F.** Galls induced by *B. byrsonimiae* on exsiccata of *B. sericea*. **G.** Galls induced by *Bruggmanniella doliocarpi* Maia, 2010 on *Doliocarpus dentatus* (Aubl.) Standl. (Dilleniaceae).

Asphondylia serrata Maia, 2004

New records. BRAZIL: state of Espírito Santo, Santa Teresa; 19°56'08"S, 040°36'01"W; Pizziolo col. leg.; Atlantic Forest, Ombrophilous Forest; voucher number: RB 295.882; state of Rio de Janeiro, Petrópolis; 22°30'18"S, 043°10'43"W; Maione, L. leg.; Atlantic Forest, Ombrophilous Forest; voucher number: RB 274.192; state of Rio de Janeiro, Nova Friburgo; 22°16'55"S, 042°31'52"W; L.G. Giordano, M. Nadruz, M.G. Bovini, R.A.M. Tavares, J.V. Barros, G. Cattan col. leg.; Atlantic Forest, Ombrophilous Forest; voucher number: RB 353.928; state of Minas Gerais, Serra Azul de Minas; 18°20'36"S, 043°10'30"W; M.S. Menandro col. leg.; Cerrado; voucher number: RB 406.365; state of Minas Gerais, Serra do Caparó; 20°31'17"S, 041°54'26"W; Brade col. leg.; Atlantic Forest; voucher number: RB 45.911.

Identification. Galls induced by *Asphondylia serrata* on leaves of *Eremanthus erythropappus* Maia, 2004 are globoid, yellowish, and one-chambered (Fig. 1B).

Bruggmanniella byrsonimae Maia & Couri, 1993

New records. BRAZIL: state of Bahia, Nova Viçosa; 17°53'31"S, 039°22'19"W, J.F. Braumgratz col.; Atlantic Forest; voucher number: RB 211.188; state of Espírito Santo, Linhares; 19°23'28"S, 040°04'20"W; C. Farney, R.D. Ribeiro, L.F.T. Menezes col. leg.; Atlantic Forest, Restinga; voucher number: RB 450.920.

Identification. Galls induced by *Bruggmanniella byrsonimae* Maia & Couri, 1993 on flower buds of *Byrsonima sericea* are claviform, brown, glabrous, and from one to three-chambered (Fig. 1C).

Bruggmanniella doliocarpi Maia, 2010

New records. VENEZUELA: Santa Lucia; 09°20'39.98"N, 069°56'10"W; W.A. Rodrigues col. leg.; Tropical Forest; voucher number: RB 147.308; BRAZIL: Distrito Federal, Planaltina; 15°27'10"S, 047°36'51"W; H.S. Irwin, R. Souza, R. Reis dos Santos col. leg.; Cerrado, Riparian Forest; voucher number: RB 147.308; state of Pernambuco, Recife, Santuário das Três Dunas; 07°57'39"S, 034°56'59"W; L.A. da Silva, K.M. Demétrio, R.B. da Silva col. leg.; Atlantic Forest, Dense Ombrophilous Forest—new phytogeographic domain record; voucher number: RB 732.975.

Identification. Galls induced by *Bruggmanniella doliocarpi* Maia, 2010 on stems of *Doliocarpus dentatus* are fusiform, brown, and glabrous (Fig. 1D).

Discussion

Asphondylia cordiae (Fig. 2) was previously known from El Salvador: La Libertad (Tropical Forest); and Brazil: Rio de Janeiro: Arraial do Cabo (Atlantic Forest, Restinga), Cabo Frio (Atlantic Forest, Restinga), Araruama (Atlantic Forest, Restinga), Saquarema (Atlantic Forest, Restinga), Maricá (Atlantic Forest, Restinga), Carapebus (Atlantic Forest, Restinga), São Francisco de Itabapoana

(Atlantic Forest, Tabuleiro Forest); São Paulo: Bertioga (Atlantic Forest, Restinga) (Möhn 1959; Maia 2001; Monteiro et al. 2004; Maia et al. 2008; Maia 2013; Maia and Souza 2013; Maia and Carvalho-Fernandes 2016; Carvalho-Fernandes et al. 2016). In these papers, the following synonyms of the host plants can be found: *Cordia dentata* Poir. (correct name: *Cordia alba*), *Cordia verbenacea* DC., and *Cordia curassavica* (Jacq.) Roem. and Schult. (correct name of both species: *Varrovia curassavica*). The distributional limits of the gall-inducing species are extended by 851 km (distance in a straight line) to the South. In Brazil, this species is restricted to the Atlantic Forest.

Asphondylia serrata (Fig. 3) was previously known from Brazil: Goiás: Parque Nacional das Emas (Cerrado); Minas Gerais: Serra do Cabral (Cerrado), Parque Nacional do Ibitipoca (Atlantic Forest), and Serra de São José (Tiradentes) (Cerrado) (Maia 2004, 2011; Coelho et al. 2013; Araújo et al. 2014). In these papers, the host plant is also referred to as *Vanillosmopsis erythropappa* (DC.) Sch. Bip., a synonym of *Eremanthus erythropappa*. The distributional limits of the galler are extended by 156 km to the East.

Bruggmanniella byrsonimae (Fig. 4) was previously known from Brazil: Rio de Janeiro: São Francisco de Itabapoana (Atlantic Forest, Tabuleiro Forest), São João da Barra (Atlantic Forest, Restinga), Carapebus (Atlantic Forest, Restinga), Arraial do Cabo (Atlantic Forest, Restinga), Araruama (Atlantic Forest, Restinga), Saquarema (Atlantic Forest, Restinga), Maricá (Atlantic Forest, Restinga), Rio de Janeiro (Atlantic Forest, Restinga), and Mangaratiba (Atlantic Forest, Restinga) (Maia et al. 1993; Monteiro et al. 1994; Maia 1999, 2001; Monteiro et al. 2004; Rodrigues et al. 2014; Maia and Carvalho 2016; Carvalho-Fernandes et al. 2016; Maia and Silva 2016). Thus, the distributional limits are extended 440 km to the north.

Bruggmanniella doliocarpi (Fig. 5) was previously known from Brazil: Minas Gerais: Dores do Indaiá (Cerrado) (Maia et al. 2010). Now, its area was extended 5.985 km to the North.

Bruggmanniella byrsonimae presented the lowest distribution area (restrict to Bahia, Rio de Janeiro, and Minas Gerais states), followed by *Asphondylia serrata* (reported in Goiás, Minas Gerais, Espírito Santo and Rio de Janeiro), while the others were more widely distributed. *Asphondylia cordiae* and *Bruggmanniella doliocarpi* were recorded not only in Brazil, but also in Venezuela and El Salvador, respectively. In Brazil, the former was reported in Minas Gerais, Espírito Santo, Rio de Janeiro, São Paulo, and Rio Grande do Sul, whereas the latter in Pernambuco, Distrito Federal, and Minas Gerais.

The current geographic distribution of *Asphondylia cordiae* and *Bruggmanniella byrsonimae* is restricted to the Atlantic Forest, while that of *Asphondylia serrata* and *Bruggmanniella doliocarpi* includes two Brazilian phytogeographic domains, Atlantic Forest and Cerrado.

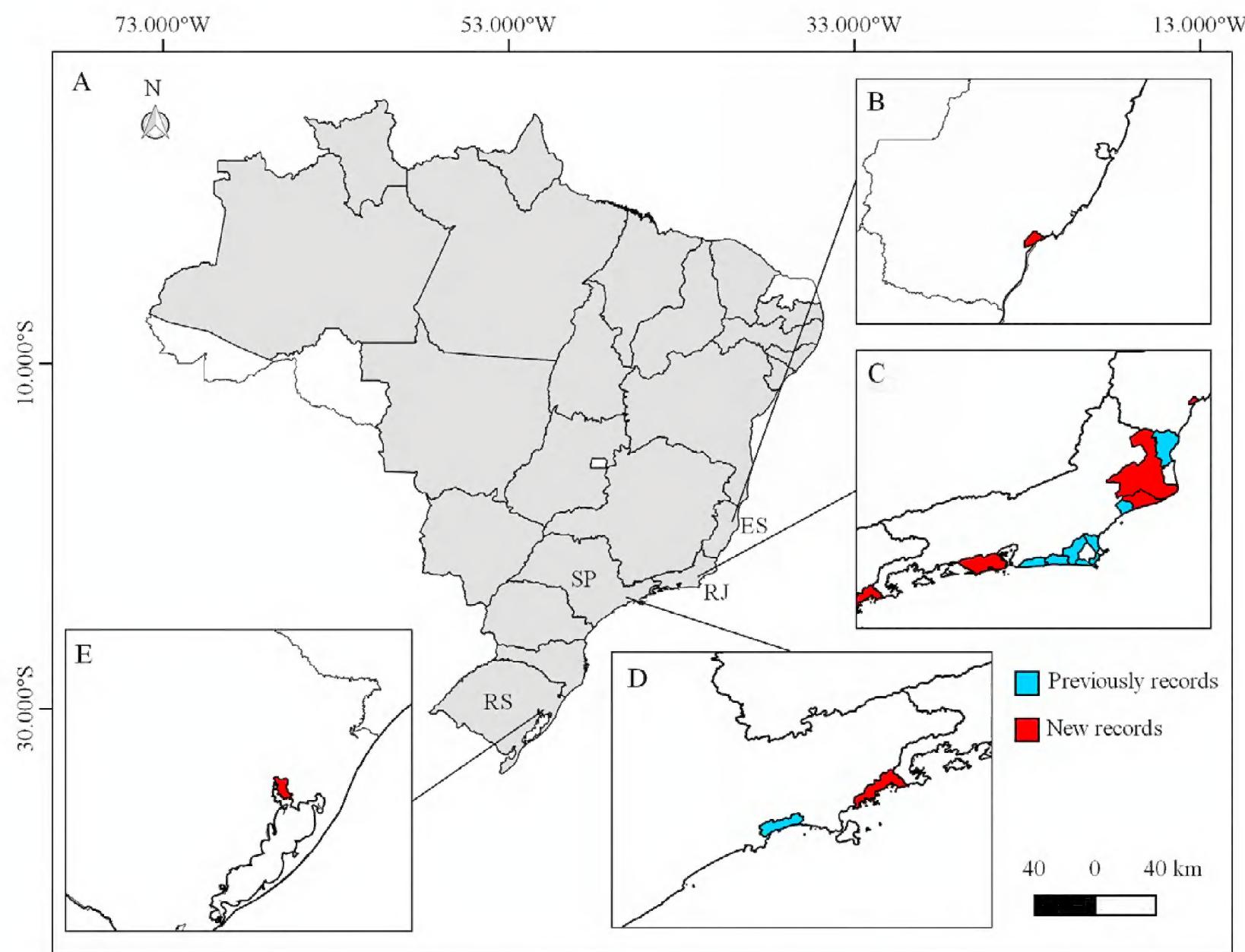


Figure 2. Geographic distribution of *Asphondylia cordiae* Mohn, 1959 (Diptera, Cecidomyiidae) and host plant *Varronia curassavica* Jacq. (Boraginaceae) in Brazil. **A.** Geographic distribution of *Varronia curassavica* (Gray color). **B-E.** *Asphondylia cordiae* records for states of Espírito Santo, Rio de Janeiro, São Paulo, and Rio Grande do Sul, respectively.

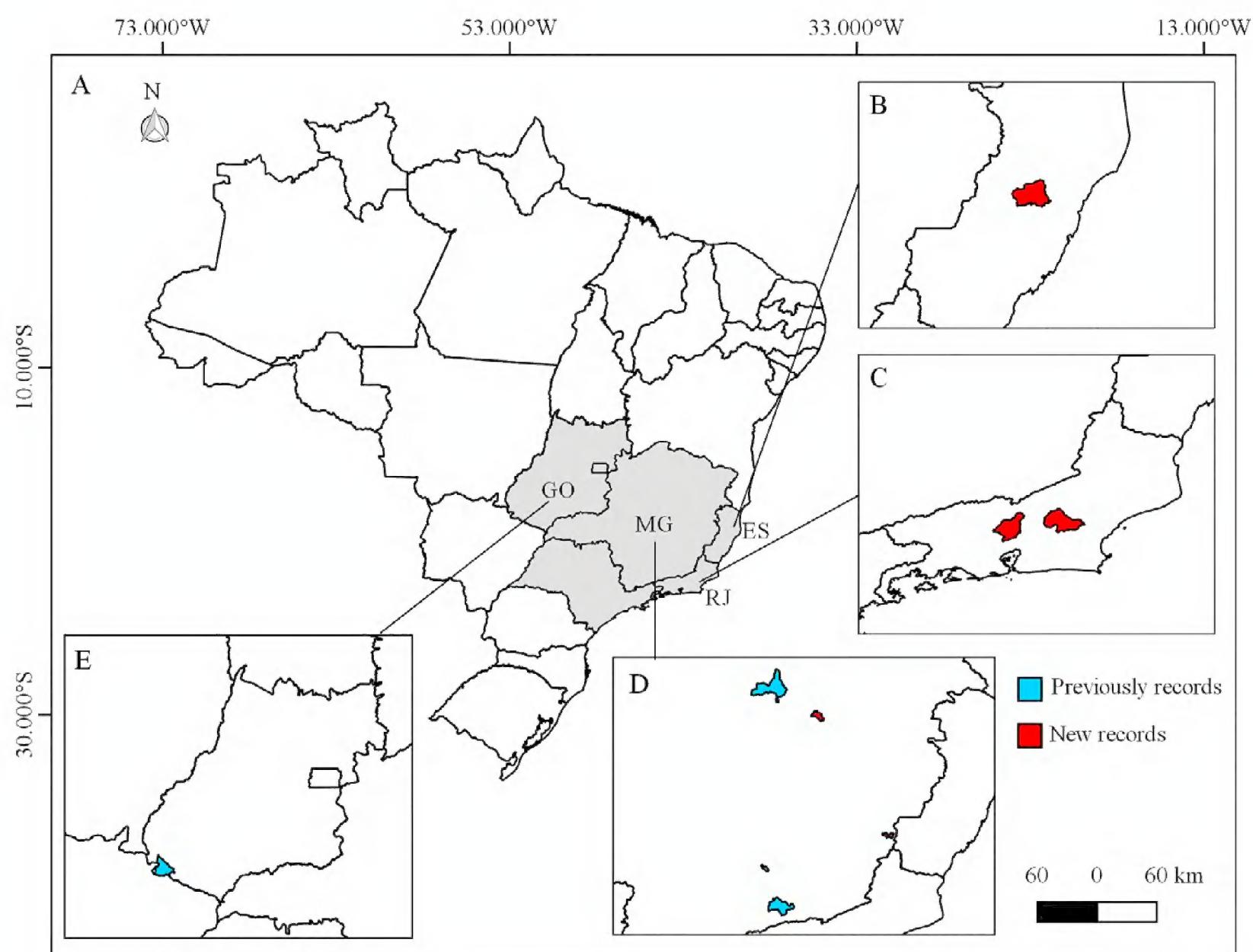


Figure 3. Geographic distribution of *Asphondylia serrata* Maia, 2004 (Diptera, Cecidomyiidae) and host plant *Eremanthus erythropappus* (DC.) MacLeish (Asteraceae) in Brazil. **A.** Geographic distribution of *Eremanthus erythropappus* (Gray color). **B-E.** *Asphondylia serrata* records for states of Espírito Santo, Rio de Janeiro, Minas Gerais and Goiás, respectively.

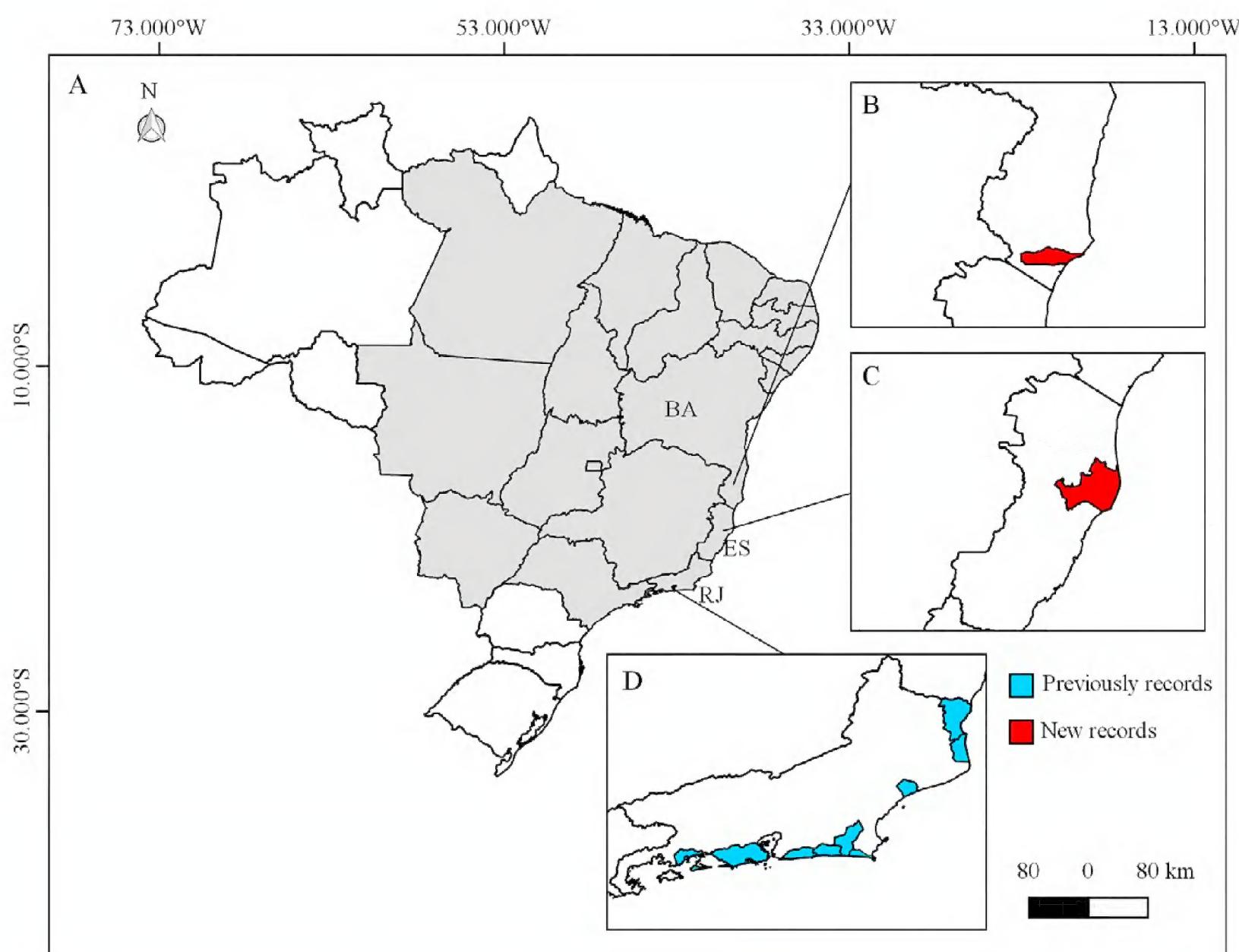


Figure 4. Geographic distribution of *Bruggmanniella byrsinimae* Maia & Couri, 1993 and host plant *Byrsinima sericea* DC. (Malpighiaceae) in Brazil. **A.** Geographic distribution of *Byrsinima sericea* (Gray color). **B–D.** *Bruggmanniella byrsinimae* records for states of Bahia, Espírito Santo, and Rio de Janeiro, respectively.

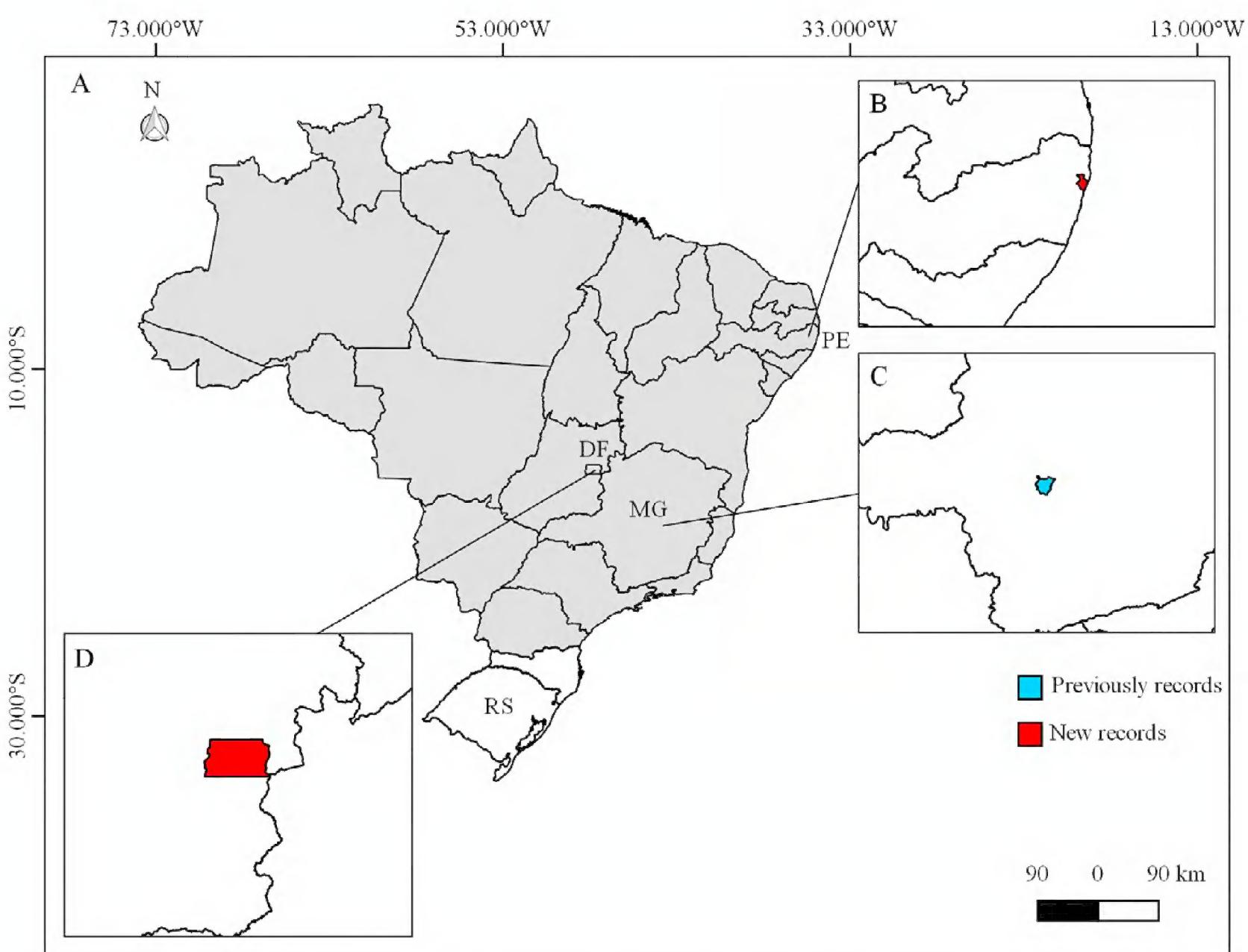


Figure 5. Geographic distribution of *Bruggmanniella doliocarpi* Maia, 2010 and host plant *Doliocarpus dentatus* (Aubl.) Standl. (Dilleniaceae) in Brazil. **A.** Geographic distribution of *Doliocarpus dentatus* (Gray color). **B–D.** *Bruggmanniella doliocarpi* records for states of Pernambuco and Minas Gerais, and Distrito Federal, respectively.

Byrsonima sericea, *Doliocarpus dentatus*, *Eremanthus erythropappus*, and *Varronia curassavica* are native plants of Brazil. Among them, *E. erythropappus* is endemic, occurring in the Atlantic Forest and Cerrado. *Varronia curassavica* and *Doliocarpus dentatus* have been recorded in five Brazilian biomes, both in the Amazon Forest, Atlantic Forest, Caatinga, and Cerrado, the former also in Pantanal, and the latter also in Pampa. The known distributional area of these plants is wider than that of their gallers. According to Arriola et al. (2016), host plant geographical distribution influences the geographical distribution of its associated galling herbivores. Due to the specific of this interaction, the distribution of the galling insects could be similar to that of their host plant. However, this was not observed, probably because of lack of sampling.

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Authors' Contributions

VCM organized work, collected the data, and wrote the manuscript. ICF corrected, revised the manuscript and made the maps.

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